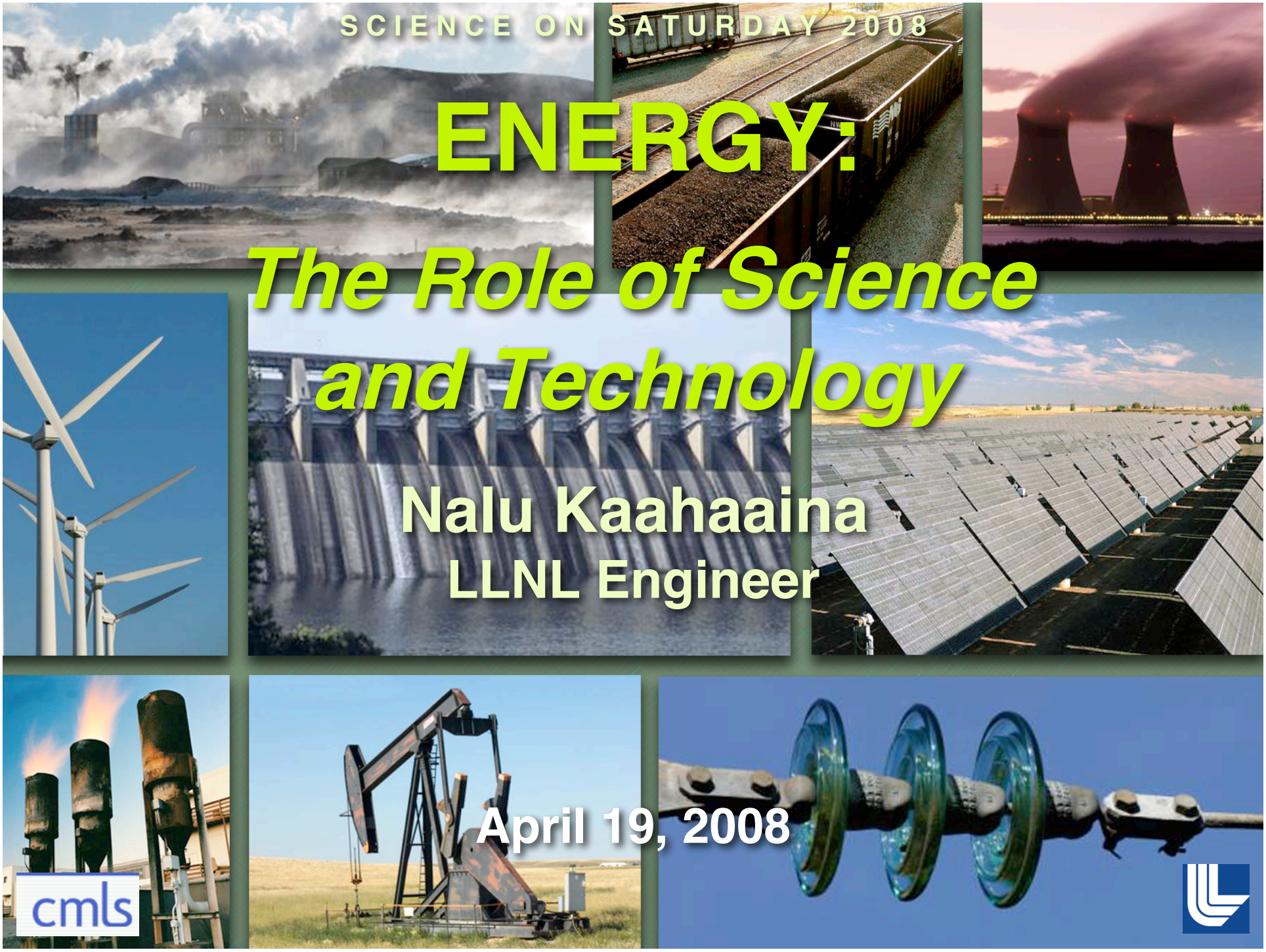
SCIENCE ON SATURDAY 2008
ENERGY:
The Role of Science and Technology
Nalu Kaahaaina
LLNL Engineer
April 19, 2008
cmls

Today's Discussion

What is energy?

How much energy do we have?

Will we run out?

Does energy impact the environment?

What is Energy?

ENERGY
Quick Overview

Energy
is a fundamental quantity in our universe

Energy
cannot be created or destroyed—
only converted

What is Energy?
"*the ability to do work*"

Different Forms of Energy

Nuclear	Uranium, Thorium
Radiation (light)	Sunlight, Microwaves
Electricity	Lightning, Wall Outlet
Chemical	Biomass, Gasoline
Sensible	Lava, Combustion Gases
Kinetic	Tides, Cars
Pressure	Wind, Hydraulics
Magnetic	Earth's Magnetic Field
Potential	Mountain Snowpack

We convert these forms to meet our needs

Hydro-electric

Potential → Kinetic → Electricity

Internal Combustion Engine

Chemical → Sensible → Pressure → Kinetic

Lighting

Electricity → Radiation (light)

How Do We Count Energy?

Counting Energy: Based on Scientific Measurements

QUANTITY	ENGLISH UNIT	METRIC UNIT
Mass	Pound-Mass (lb-m)	gram (g)
Length	foot (ft), mile (mi)	meter (m)
Time	second (s)	second (s)

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Force = Mass * Acceleration	Pound-Weight (lbf or lb)	Newton (N)

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	Calories (cal)	
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You need science to understand energy

Common forms of energy and how they are measured

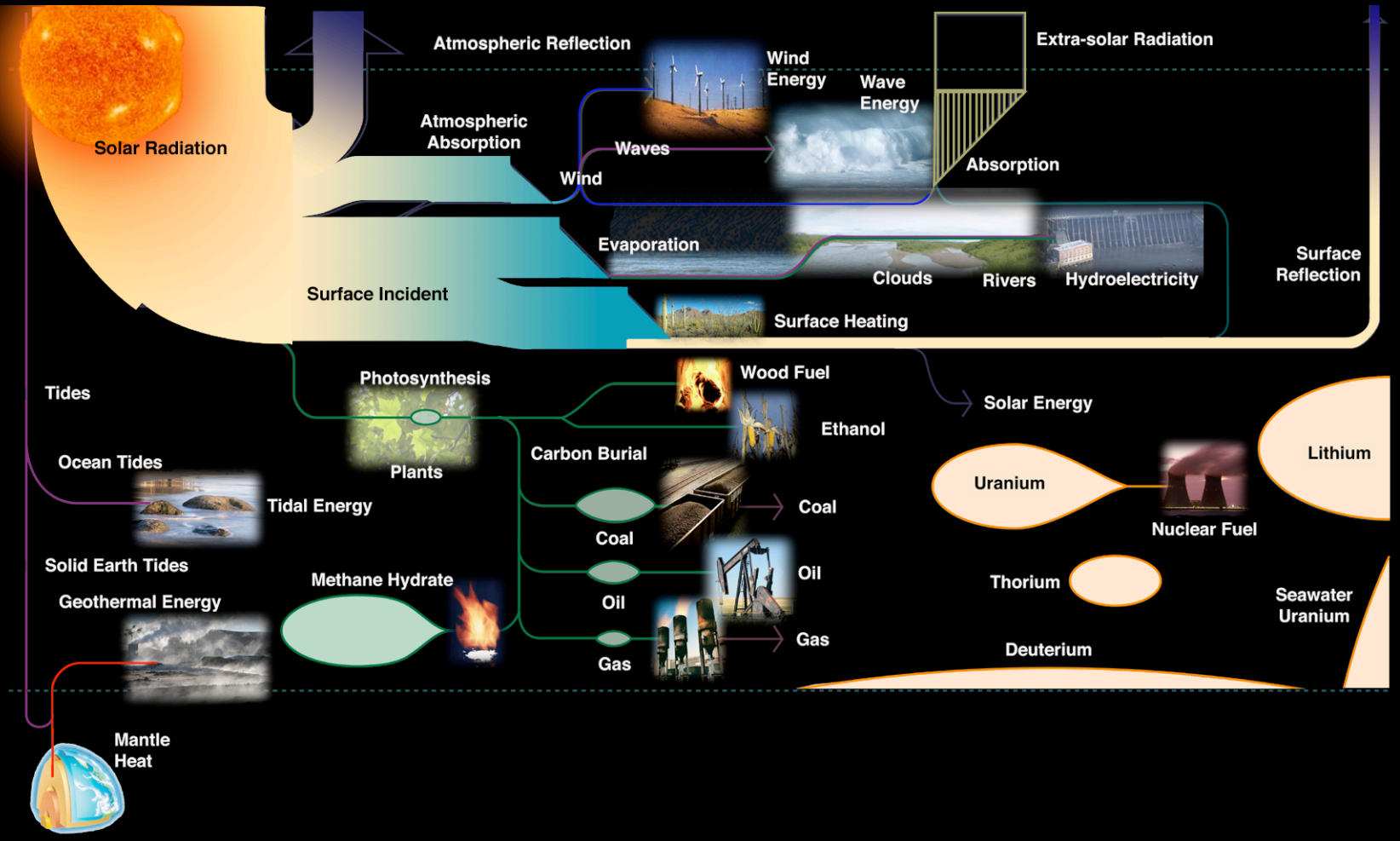
Form	Common Name	Unit
	**Food**	Calories
	**Heating, cooking, and industrial uses**	Joules or BTUs
	**Electricity (lighting, appliances, refrigeration, heating)**	Kilowatt-hours (kWh)
	**Transportation (people and goods)**	Gallons (gasoline), Barrels (oil)

Adding It Up

Form	Common Name	Unit
	**Food (for one person)**	Calories **~2,500 kcal/day**
	**Heating, cooking, and industrial uses (average U.S. home)**	Joules or BTUs ~125,000 BTU/day
	**Electricity (average U.S. home)**	Kilowatt-hours (kWh) ~25 kWh/day
	**Transportation (12,000 miles/yr)**	Gallons (gasoline) ~1.5 gallons/day

How Much Energy Do We Have?

Global energy resources: Power (in TW) and Energy (in ZJ) are drawn to scale



From Wes Hermann, GCEP, 2005

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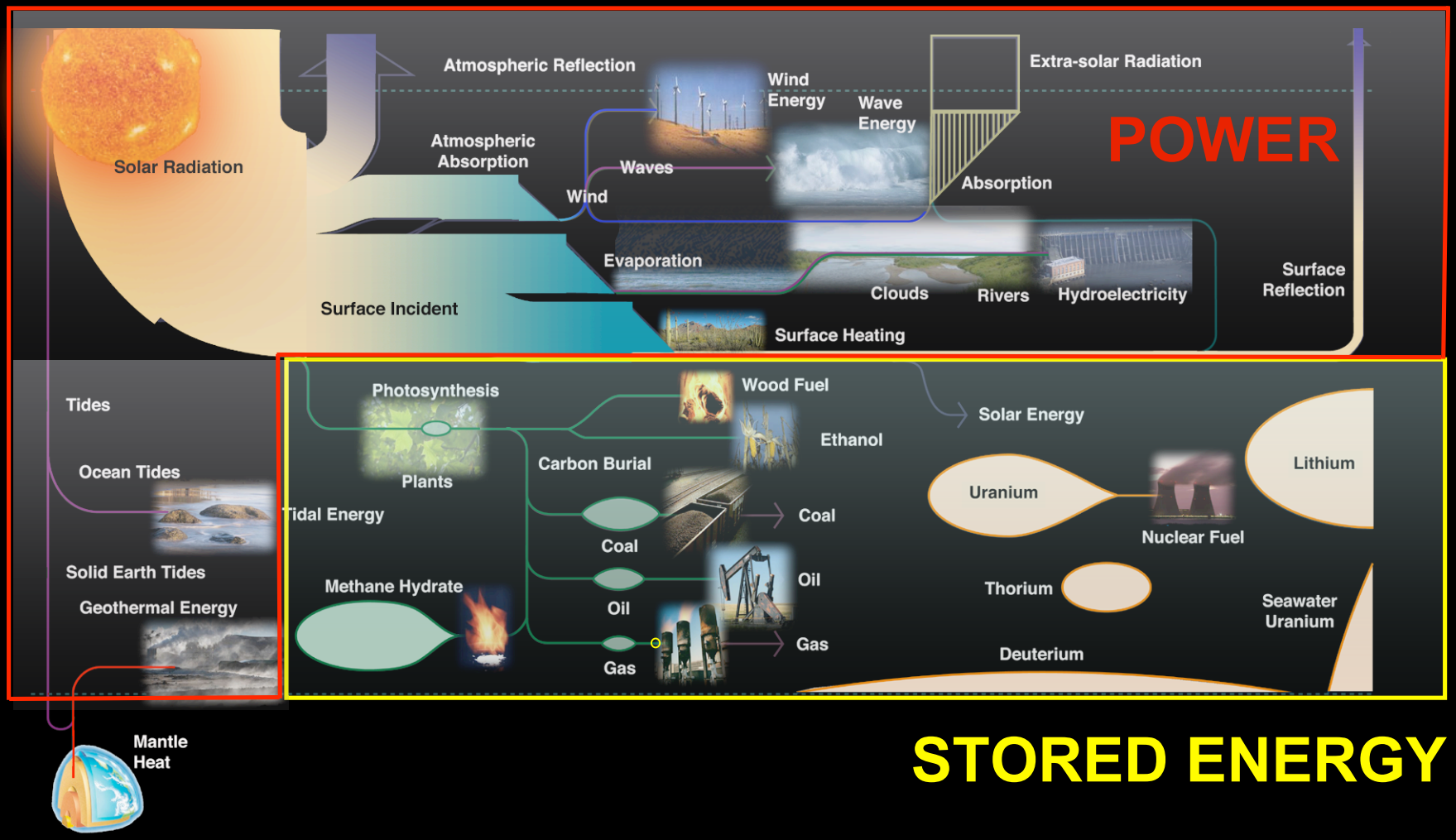

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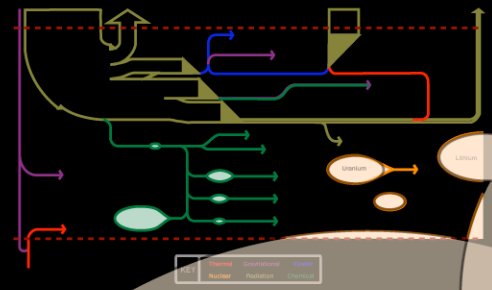


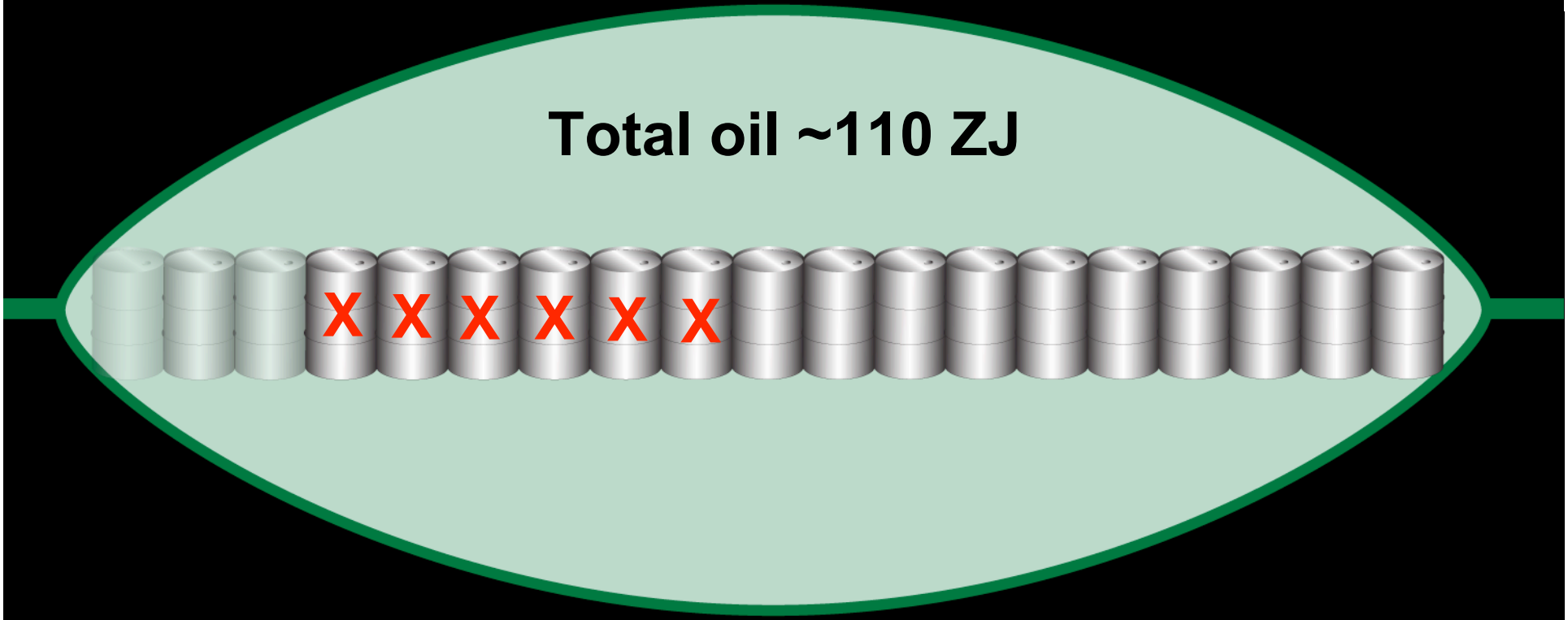
Fission Energy

Fusion Energy

Will We Run Out?

World Oil Is ~19 Trillion Barrels

World Has Used 1 Trillion Barrels

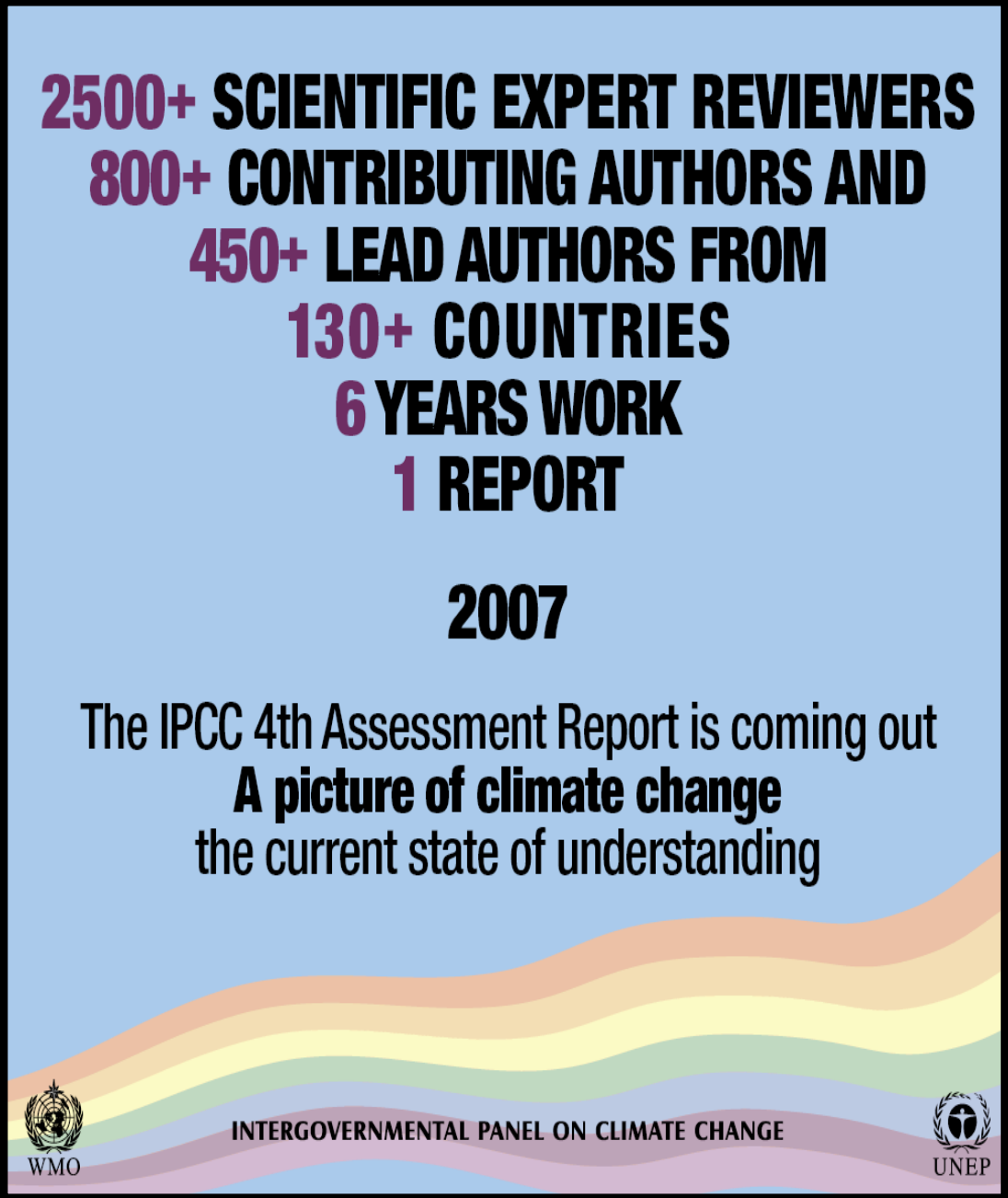


Recoverable oil: 1 or 2 Trillion barrels

Including oil “left behind”: ~10 Tbbls left

Show Energy Map

Does Energy Impact The Environment?



Most scientists now agree that global climate change is real

And that man's energy use is the main cause

Problem: burning fossil fuels

What About The Rest of the World? India and China

China:

Most populous nation (1.3 billion people)

Per-Person Energy Use is ~1/6th of U.S.

India:

Second most populous nation (1.1 billion people)

Per-Person Energy Use is ~1/16th of U.S.

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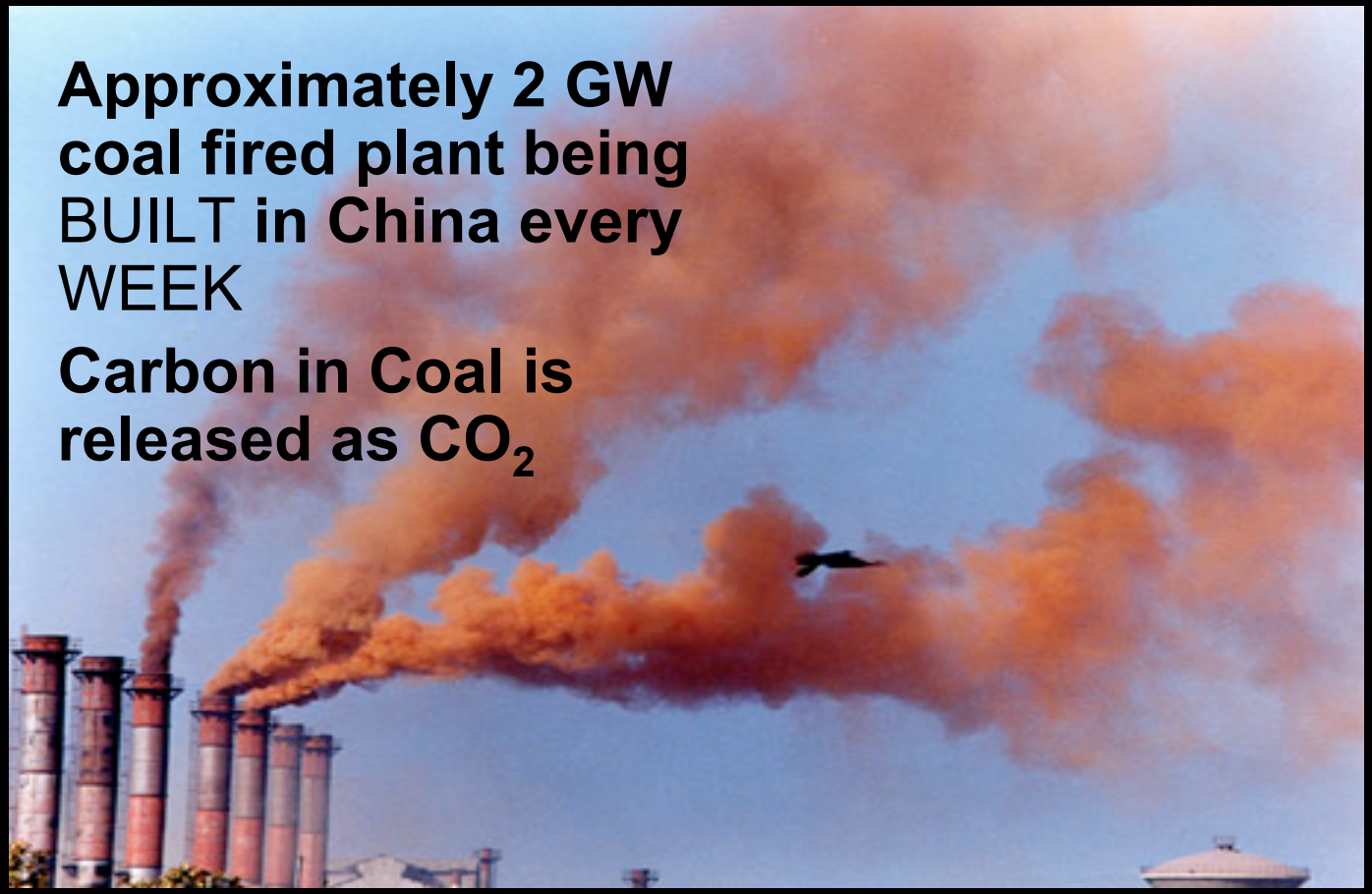
Hypothetical Situation: If population holds constant, and only India and China reach the same per-person energy needs as the U.S….

i) World Energy Demand will be 2.5x higher than today

ii) We add one and a half planet's worth of emissions

China and India will influence greenhouse emissions



from ***The Economist***

Is There An Energy Crisis?

What do you think?


How about you spend LESS time studying how MY generation destroyed the environment and MORE time figuring out a magical solution?
BIZARRO.COM
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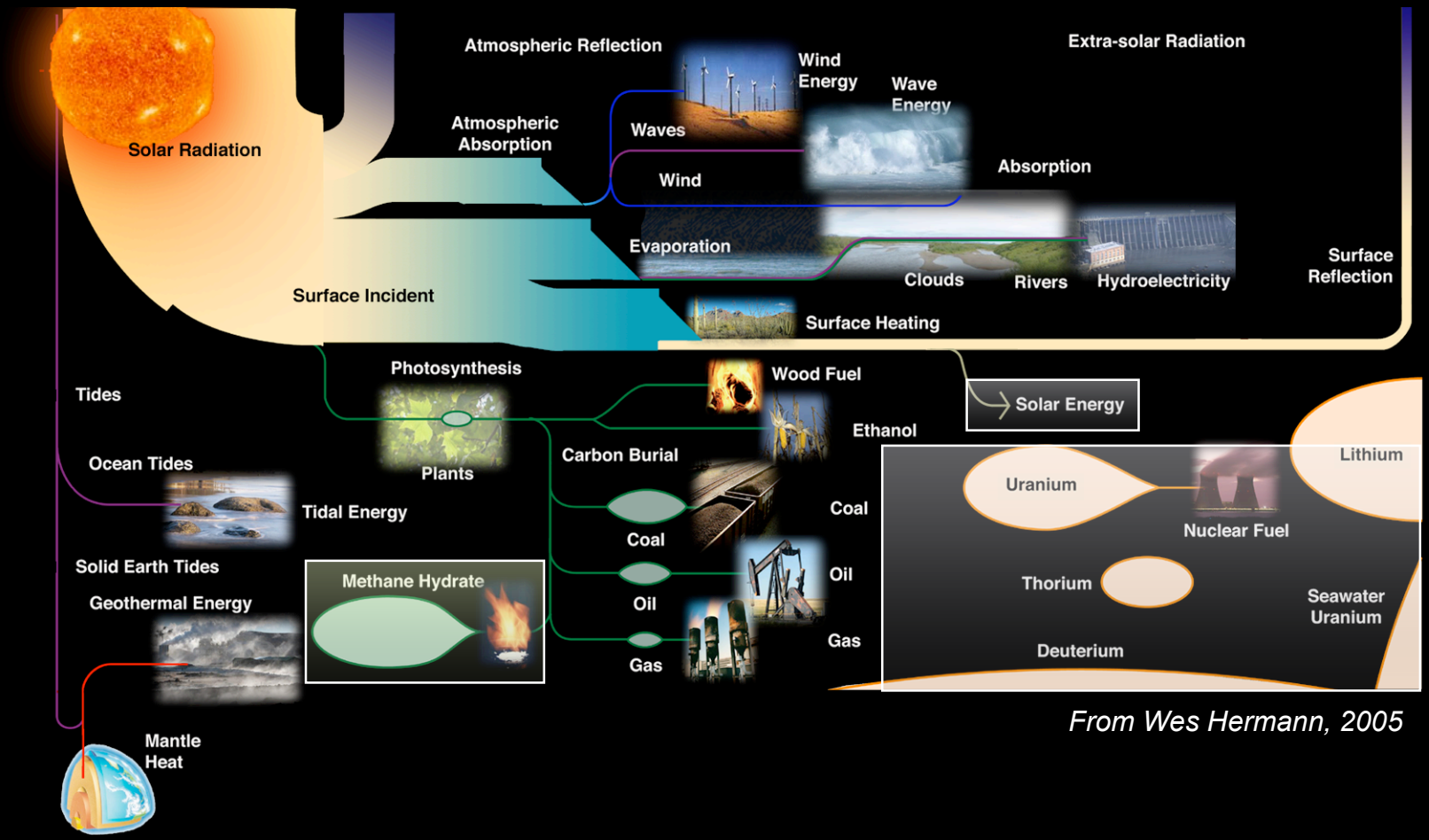
The Role of Technology

What can we do?



From Wes Hermann, 2005

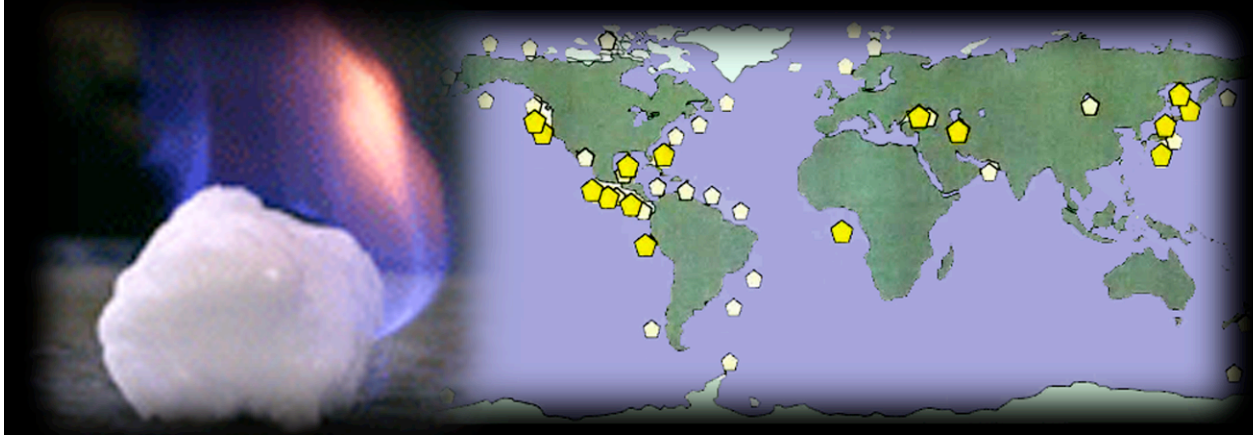
Three options: find more fossil fuels, harness renewables, and more nuclear energy

Get More Fossil Fuels (for now)

"Oil Shale"

U.S. has 90%

1.6 trillion barrels

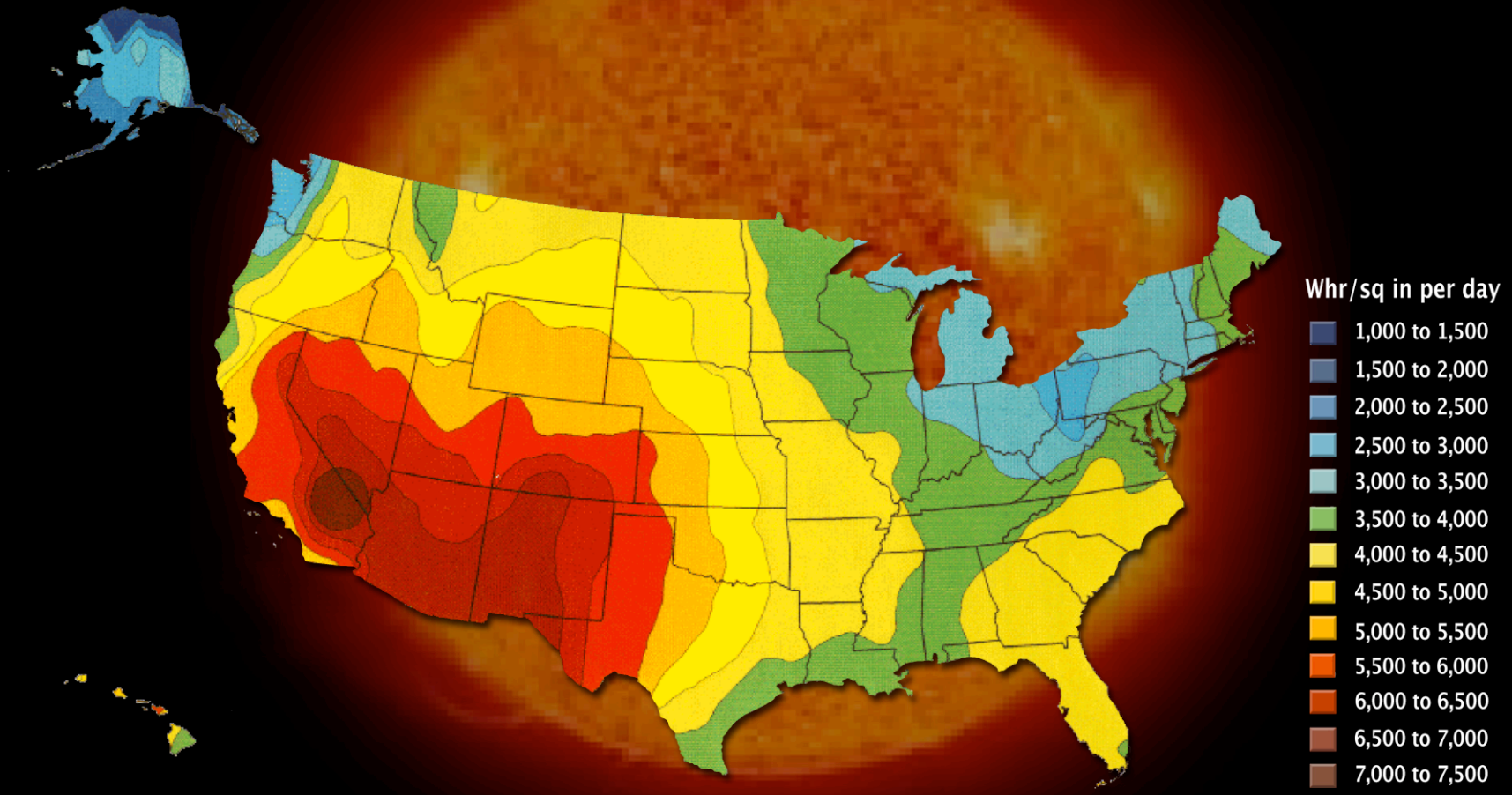


Methane hydrates

(Twice all other fossil fuels)

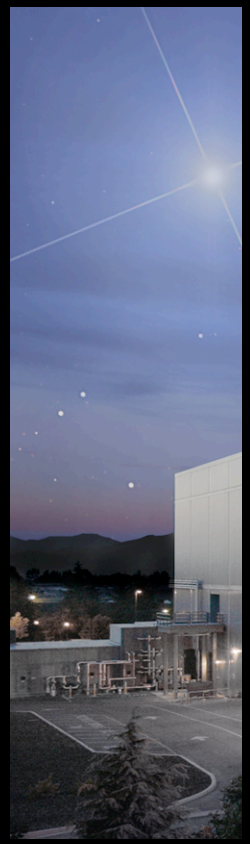
Use More Renewables

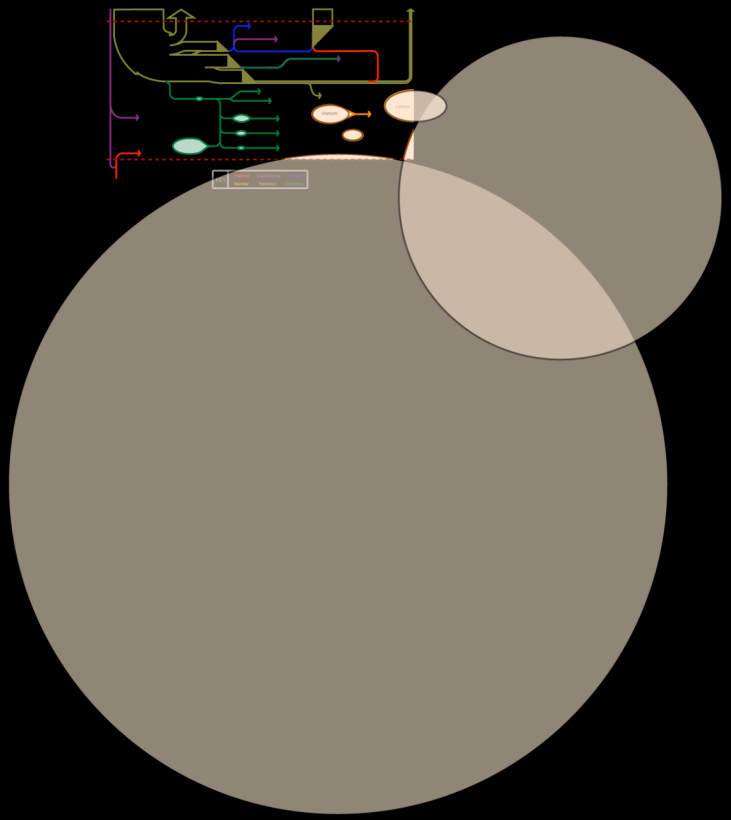
Low-cost solar, more wind, geothermal and efficient biofuels

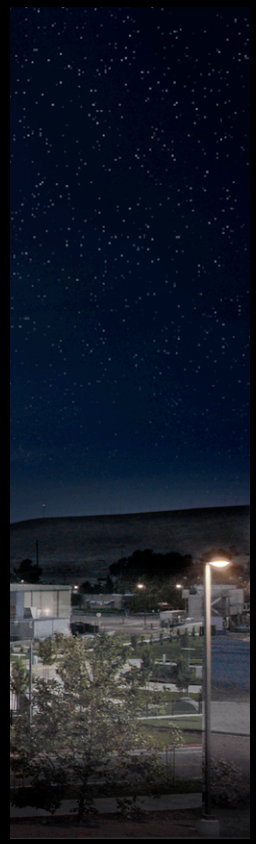


Energy from Windmills floating in the sky (sending electricity 20,000 feet down)

Fusion: a sun on the earth







Unlimited energy from water!

What did we learn?

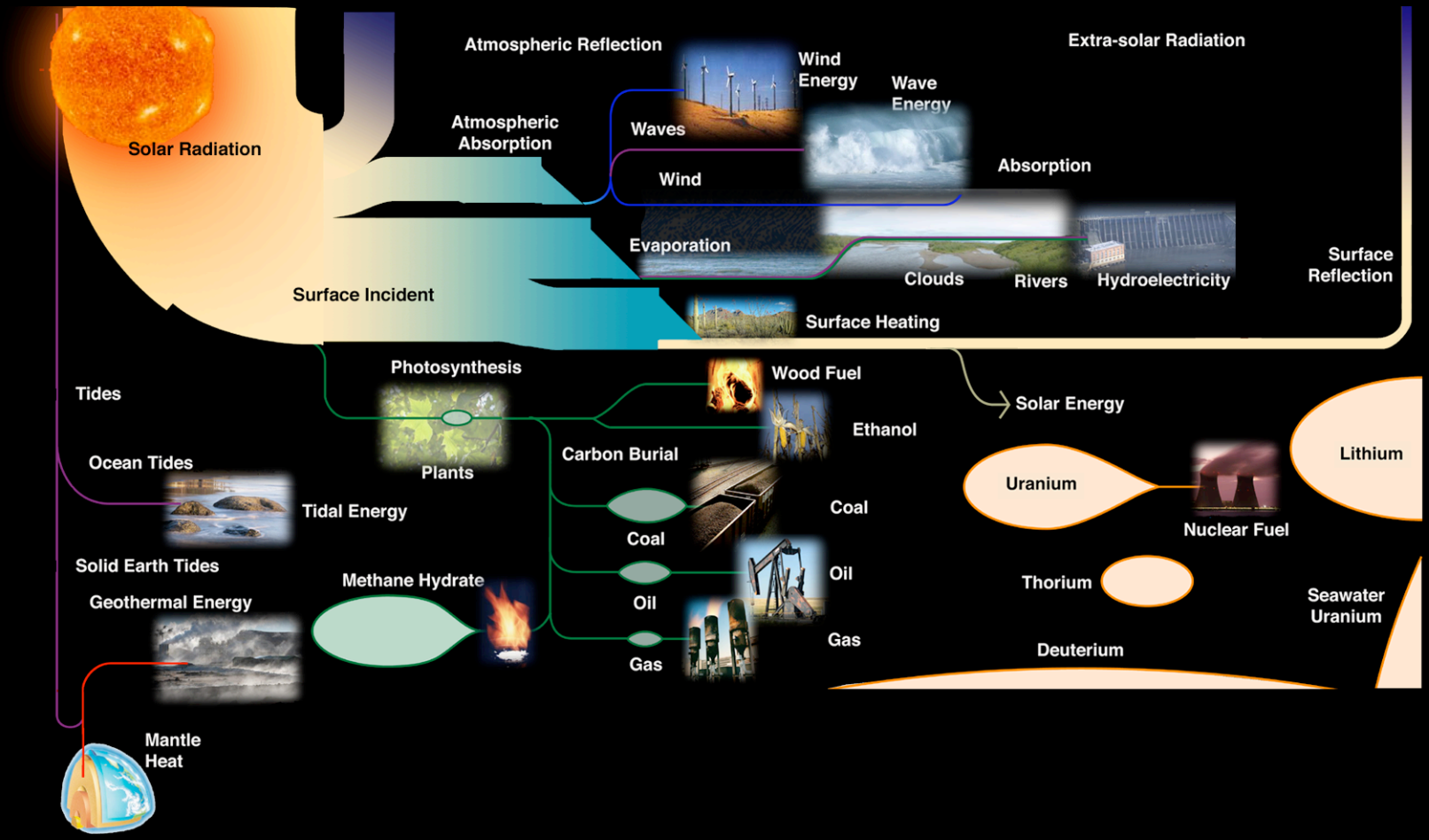
You need science to understand energy and its different forms

We use energy in many ways, every day

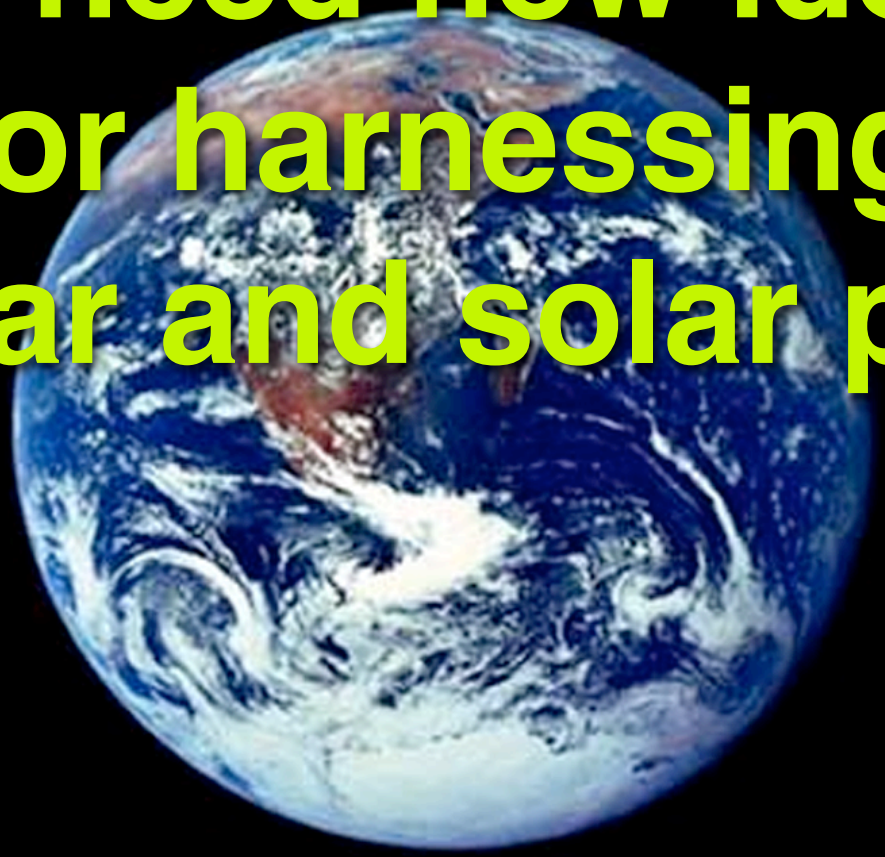

The sun sends us huge amounts of energy…
we just don’t harness it!


Today, most of the
energy we use is
from fossil fuels

Our future will depend on many technologies and resources



The Future:
We need new ideas for harnessing nuclear and solar power



The challenge is yours!